Electronic Circuits I

PART A

1. **Why do we choose q point at the center of the loadline?**

   The operating point of a transistor is kept fixed usually at the center of the active region in order that the input signal is well amplified. If the point is fixed in the saturation region or the cut off region the positive and negative half cycle gets clipped off respectively.

2. **Name the two techniques used in the stability of the q point .explain.**

   Stabilization technique: This refers to the use of resistive biasing circuit which allows I_B to vary so as to keep I_C relatively constant with variations in I_{co},β, and V_{BE}.

   Compensation techniques: This refers to the use of temperature sensitive devices such as thermistors diodes. They provide compensating voltages &currents to maintain operating point constant.

3. **Give the expression for stability factor.**

   $S= (1+\beta)/[(1- \beta)(\delta I_B/ \delta I_{C)}]$

4. **List out the different types of biasing.**
   - Voltage divider bias
   - Base bias
   - Emitter feed back bias
   - Collector feedback bias

5. **What do you meant by thermal runway?**

   Due to the self heating at the collector junction, the collector current rises. This causes damage to the device. This phenomenon is called thermal runway.

6. **Why is the transistor called a current controlled device?**

   The output characteristics of the transistor depend on the input current. So the transistor is called a current controlled device.

7. **Define current amplification factor?**

   It is defined as the ratio of change in output current to the change in input current at constant other side voltage.

8. **What are the requirements for biasing circuits?**
   - The q point must be taken at the Centre of the active region of the output characteristics.
   - Stabilize the collector current against the temperature variations.
   - Make the q point independent of the transistor parameters.
   - When the transistor is replaced, it must be of same type.

9. **When does a transistor act as a switch?**

   The transistor acts as a switch when it is operated at either cutoff region or saturation region.

10. What is biasing?

To use the transistor in any application it is necessary to provide sufficient voltage and current to operate the transistor. This is called biasing.

11. What is operating point?

For the proper operation of the transistor a fixed level of current and voltages are required. This values of currents and voltages defined at a point at which the transistor operate is called operating point.

12. What is stability factor?

Stability factor is defined as the rate of change of collector current with respect to the rate of change of reverse saturation current.

13. What is d.c load line?

The d.c load line is defined as a line on the output characteristics of the transistor which gives the value of Ic & Vce corresponding to zero signal condition.

14. What are the advantages of fixed bias circuit?

This is simple circuit which uses a few components. The operating point can be fixed any where on the Centre of the active region

15. Explain about the various regions in a transistor?

The three regions are active region saturation region cutoff region.

16. Explain about the characteristics of a transistor?

Input characteristics: it is drawn between input voltage & input current while keeping output voltage as constant.

Output characteristics: It is drawn between the output voltage &output current while keeping input current as constant.

17. What is the necessary of the coupling capacitor?

It is used to block the c signal to the transistor amplifier. It allows a c &blocks the d c.

18. What is reverse saturation current?

The current due to the minority carriers is called the reverse saturation current.

19. Why is the operating point selected at the Centre of the active region?

The operating point is selected at the Centre of the active region to get to perfect amplification. Moreover there is no distortion.

20. What are the basic rules of an operating amplifier?

The operating point should be fixed on the load line. The upper end of the load line lies on the saturation region &lower end lies on the cutoff region.

21. What is an amplifier?

An amplifier is a device which produces a large electrical output of similar characteristics to that of the input parameters.

22. How are amplifiers classified according to the input?

1. Small – signal amplifier 2. Large – signal amplifier

23. How are amplifiers classified according to the transistor configuration?

1. Common emitter amplifier 2. Common base amplifier 3. Common collector amplifier

24. What is the different analysis available to analyze a transistor?

1. AC analysis 2. DC analysis

25. How can a DC equivalent circuit of an amplifier be obtained?

By open circuiting the capacitor.

26. How can a AC equivalent circuit of a amplifier be obtained?

By replacing dc supply by a ground and short- circuiting capacitors.

27. What is feed back?

It is the process of injecting some energy from the output and then returns it back to the input.

28. What are feed back amplifiers?

Amplifiers which uses feed back principle is called as feed back amplifiers.

29. What are the types of feed back?

1. Positive feedback 2. Negative feedback.

30. What is positive feedback?

If the feed back signal is applied in such a way that it is in phase with the input signal and thus increases it is said to be positive feedback.

31. What is negative feed back?

If the feed back signal is applied in such a way that it is out of phase with the input signal and thus decreases it is said to be positive feedback.

32. Which feedback decreases the gain of the amplifier?

Negative feed back

33. Which feedback increases the gain of the amplifier?

Positive feedback

34. What is the advantage of negative feed back?

1. increased stability 2. Increased bandwidth 3. Decreased noise 4. Less frequency distortion

35. What is the disadvantage of negative feed back?

Reduces amplifier gain.

36. Define sensitivity.

It is the ratio of percentage change in voltage gain with feedback to the percentage change in voltage gain without feed back.

37. Define Desensitivity.

It is the ratio of percentage change in voltage gain without feedback to the percentage change in voltage gain with feed back. the reciprocal of sensitivity.

38. What is an op-amp?

The operational amplifier is a multi-terminal device, which is quite complex internally. An operational amplifier is a direct coupled high gain amplifier usually consisting of one or more differential amplifiers and usually followed by a level translator and an output stage. An operational amplifier is available as a single integrated circuit package. It is a versatile device that can be used to amplify dc as well as ac input signals and was originally designed for computing such mathematical functions.

39. What are the characteristics of ideal op-amp?

a. Open loop voltage gain, (AOL) = ∞

b. Input impedance (Ri) = ∞

c. Output impedance (Ro) = 0

d. Bandwidth (BW) = ∞

e. Zero offset Vo = 0, when V1 = V2 = 0

40. Define loading?

A large value of Rc cannot be used in a circuit since,a large value of resistance requires a large chip area.

For large Rc, quiescent drop across it increases and hence a large power supply is required.

These difficulties removed by using a current source. Hence, a current source can also be used as an active load for an amplifier to obtain a very large voltage gain.

41. Define input offset voltage?

It is defined as the voltage that must be applied between the input terminals of an op-amp to nullify the output.

42. Define input offset current?

It is defined as the algebraic difference between the current entering the inverting and non-inverting terminal of an op-amp.

43. Define input bias current?

It is defined as the average of the currents entering into the input terminals of an op-amp.

44. What are the two compensating techniques used in frequency compensation?

Two types of compensating techniques are used, they are,

a. External compensation
b. Internal compensation

45. What is compensated op-amp?

Op-amp, which uses a capacitor internally for compensation, is called a compensated op-amp. This op-amp has a high gain stability and low bandwidth.

46. What are the methods used in external compensation technique?

a. Dominant-pole compensation
b. Pole-zero compensation

47. Define slew rate?

Slew rate can be defined as the maximum rate of change of output voltage of op-amp with respect to time.

48. How can the slew rate be made faster?

The slew rate can be made faster by having a high charging current or a small capacitance value.

49. What are the methods to improve slew rate?

a. The slew rate can be improved with higher closed-loop gain and dc supply voltage. But the slew rate also varies with temperature. i.e., slew rate decreases with increase in temperature.
b. Another method for improving slew rate is, the rate at which voltage across the capacitor increases is gain by,

$$dVc/dt = I / C.$$

where, I is the maximum current furnished by the op-amp to the capacitor C. From the equation it is clear that for a higher slew rate, op-amp should have either a higher current or a small value of capacitor.

50. What are the AC characteristics of an op-amp?

a. Frequency response
b. Slew rate

51. What are the DC characteristics of an op-amp?
a. input bias current
b. Input offset current
c .Input offset voltage
d. Thermal drift

52. What is the type of feedback employed in the inverting op-amp amplifier?
Negative feedback is employed in the inverting op-amp amplifier.

53. List the applications of instrumentation amplifier.
a. Temperature indicator b. Temperature controller c. Light intensity meters d. Water flow meter
c. Thermal conductivity meter f. Analog weight scale

54. What is the basic building block of an op-amp?
The basic building block of an op-amp is differential amplifier.

55. Define non-inverting amplifier?
The input is applied to the non-inverting input terminal and the inverting terminal connected to the ground.

56. What is meant by voltage follower?
If the output voltage of an op-amp follows the input i.e., if the output voltage is equal to the input voltage it is called as a voltage follower.

57. Define Common Mode Rejection Ratio.
The relative sensitivity of an op-amp to a difference signal as compared to a common mode signal is called common-mode and gives the figure of merit ρ for the differential amplifier.

$$\text{CMRR, } \rho = |Ad/Ac|$$

58. What is a Multivibrator?
Multivibrator is a wave shaping circuit which gives symmetric or asymmetric square wave output. It has two states. They may be either stable or quasi stable depends upon the type of the Multivibrator.

59. What is Astable Multivibrator?
Astable Multivibrator is a square wave circuit. It has two quasi stable states. It is also referred as free running Multivibrator.

60. What is a monostable Multivibrator?
A monostable Multivibrator is a square wave shaping circuit having one stable state and another quasi stable state. It is often referred as single shot Multivibrator. It is also used as gating circuit and delay circuit.

61. What is the type of feedback used in an op-amp Schmitt trigger?
The type of feedback used in an op-amp Schmitt trigger is positive feedback.

62. Give the expression for the frequency of oscillations in an op-amp sine wave oscillator?
The expression for the frequency of oscillations in an op-amp sine wave oscillator is,

$$f = 1 / (2\pi RC)$$

63. What are the conditions for sustained oscillator or what is Barkhausen criterion?

Condition for sustained oscillation,

a. Magnitude condition $|A\nu\beta| = 1$
b. Phase condition $\angle A\nu\beta = 0°$

These conditions are called as Barkhausen criterion.

64. What is Oscillator circuit?

A circuit with an active device is used to produce an alternating current is called an oscillator circuit.

65. What are the classifications of Oscillators?

*<u>Based on wave generated:</u>

i. Sinusoidal Oscillator,
ii. Non-sinusoidal Oscillator or Relaxation Oscillator

Ex: Square wave, Triangular wave, Rectangular wave etc.

*<u>According to principle involved:</u>

i. Negative resistance Oscillator, ii. Feedback Oscillator.

*<u>According to frequency generated</u>:

i. Audio frequency oscillator
20 Hz – 20 kHz
ii. Radio frequency Oscillator
30 kHz – 30 MHz
iii. Ultrahigh frequency Oscillator
30 MHz – 3 GHz
iv. Microwave Oscillator
3 GHz – above.

* Crystal Oscillators.

66. What are the types of feedback oscillators?

* RC-Phase shift Oscillator,
* LC-Oscillators

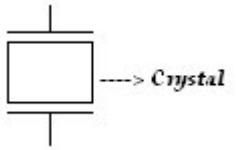
i. Tuned collector Oscillator
ii. Tuned emitter Oscillator
iii. Tuned collector base Oscillator
iv. Hartley Oscillator
v. Colpits Oscillator
vi. Clap Oscillator

67. What are the conditions for oscillation?

The total phase shift of an oscillator should be 360o. For feedback oscillator it should satisfies Barhausen criterion.

68. Define Piezoelectric effect.

When applying mechanical energy to some type of crystals called piezoelectric crystals the mechanical energy is converted into electrical energy is called piezoelectric effect.



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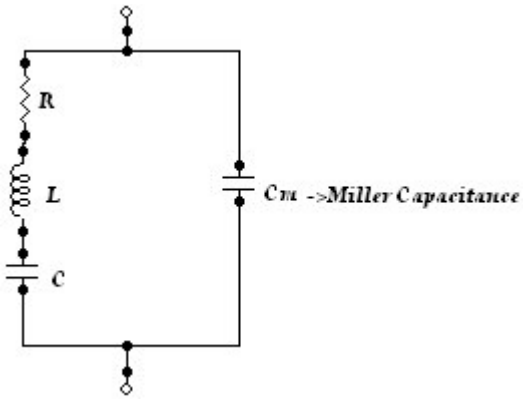
69. Draw the equivalent circuit of crystal oscillator.



70. What is Miller crystal oscillator? Explain its operation**.**

It is nothing but a Hartley oscillator its feedback Network is replaced by a crystal.

Crystal normally generate higher frequency reactance due to the miller capacitance are in effect between the transistor terminal.

71. State the frequency for RC phase shift oscillator**.**

The frequency of oscillation of RC-phase shift oscillator is

$$F=1/2\Pi RC\sqrt{}\ (4k+6)$$

Where k=2.639.

72. .List the important characteristics of a voltage regulator.

The output voltage is fixed at a specified value, The unregulated voltage must be at least 2V more than the regulated voltage.

73. What is a Schmitt trigger?

Schmitt trigger is a regenerative comparator. It converts sinusoidal input into square wave output. The output of Schmitt trigger swings between upper threshold voltage and lower threshold voltage, the reference voltages of the input waveform.

74. What is a tuned amplifier?

The amplifier with a circuit that is capable of amplifying a signal over a narrow band of frequencies are called tuned amplifiers.

75. What is the expression for resonant frequency?

fr=1/2∏√LC

76. What happens to the circuit above and below resonance?

Above resonance the circuit acts as capacitive and below resonance the circuit acts as inductive.

77. What are the different coil losses?

Hysteresis loss
Copper loss
Eddy current loss

78. What is Q factor?

It is the ratio of reactance to resistance.

79. What is dissipation factor?

It is referred as the total loss within a component i.e1/Q

80. What is the classification of tuned amplifiers?

Single tuned
Double tuned
Stagger tuned

81. What is a single tuned amplifier?

A single tuned amplifier circuit that uses a single parallel tuned circuit as a load is called single tuned amplifier.

82. What are the advantages of tuned amplifiers?

- ❖ They amplify defined frequencies.
- ❖ Signal to noise ratio at output is good
- ❖ They are suited for radio transmitters and receivers

83. What are the disadvantages of tuned amplifiers?

- The circuit is bulky and costly
- The design is complex.
- They are not suited to amplify audio frequencies.

84. What is neutralization?

The effect of collector to base capacitance of the transistor is neutralized by introducing a signal that cancels the signal coupled through collector base capacitance. This process is called neutralization.

85. What are double tuned amplifiers?

The amplifiers having two parallel resonant circuit in its load are called double tuned amplifiers.

86. What is a stagger tuned amplifier?

It is a circuit in which two single tuned cascaded amplifiers having certain bandwidth are taken and their resonant frequencies are adjusted that they are separated by an amount equal to the bandwidth of each stage. Since resonant frequencies are displaced it is called stagger tuned amplifier.

87. What are the advantages of stagger tuned amplifier?

The advantage of stagger tuned amplifier is to have better flat, wideband characteristics.

88. What are the advantages of double tuned over single tuned?

1. Possess flatter response having steeper sides
2. Provides larger 3 db bandwidth
3. Provides large gain-bandwidth product.

89. What are the different types of neutralization?

1. Hazeltine neutralization
2. Rice neutralization
3. Neutrodyne neutralization.

90. What is rice neutralization?

It uses center tapped coil in the base circuit. The signal voltages at the end of tuned base coil are equal and out of phase.

91. What is unloaded Q?

It is the ratio of stored energy to the dissipated energy in a reactor or resonator.

92. What are the applications of mixer circuits?

Used in radio receivers. Used to translate signal frequency to some lower frequency

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100. Define Quality factor.

Quality factor is defined as the ratio of voltage across the inductance and voltage across the resistance.

PART B

1. Explain the AC and DC Analysis of Common Emitter amplifier .

Feed back resistance and by pass capacitance.
Basic Common Emitter amplifier explanation with diagram (4 marks)
Ac and dc analysis with equivalent circuits (4 marks)
Ac and dc analysis with emitter feed back resistance (4 marks)
Ac and dc analysis with by pass capacitance (4 marks)
All the parameters in the analysis are to be given with a relation.

2.Explain the AC and DC Analysis Common Base Amplifier**.**

Basic Common base amplifier explanation with diagram (4 marks)
Ac analysis with equivalent circuits (6 marks)
Dc analysis with equivalent circuits (6 marks)
All the parameters in the analysis are to be given with a relation.

3.Explain the AC and DC Analysis Common collector Amplifier.

Basic Common collector amplifier explanation with diagram (4 marks)
Ac analysis with equivalent circuits (6 marks)
Dc analysis with equivalent circuits (6 marks)
All the parameters in the analysis are to be given with a relation.

4..Explain the Concepts of Feed back in Amplifier.(8marks)

Definition of Feed back (2 marks)
Types & explanation of it (2 marks)
Derivation of voltage gain a feed back amplifier (4marks)

5. Give the properties of Negative feedback.(8marks)

Definition of Negative Feed back (2 marks)
Minimum of 4 properties with related diagram and relations (6marks)

6.Explain the Ideal Op-amp characteristics.(8marks)

Total of five characteristics to be explained. Importance is to be given to values of each parameter and reason for that value.

7.. Explain Op-Amp characteristics.

Dc characteristics (8marks)
All the four characteristics have to be explained with proper diagrams.
Ac characteristics (8marks)
Two characteristics in this case have to be explained with proper diagrams.

8. Explain any 4 applications of operation amplifier**.**

There are several applications such as adder, subtractor , multiplier , integrator … etc
Each application may carry 4 marks and have to eb presented with diagrams and derivation of relation.

9. Explain in detail Inverting, non inverting operational amplifier and Differential amplifier.

Inverting , non inverting operational amplifier(10 marks)
Diagram, working and derivation of relation required.
Differential amplifier(6marks)

Diagram, working and derivation of relation required.

10. Explain OP-Amp parameters in detail. (8marks)
    All the parameters needed to be explained with the proper relation for each of the parameter**.**

11. What are sinusoidal oscillators? Explain any two sinusoidal oscillators?
    Definition (2marks)
    Diagram, working and derivation of relation required (6marks)
    Types and its operation (12marks)

12. Explain the concept involved in crystal oscillator with its characteristics?
    Definition (2marks)
    Diagram, working, characteristics , relation required (6marks)

13. What is a Multivibrator? Explain Astable and Monostable Multivibrators.
    Definition (2marks)
    Diagram, working and derivation of relation required (6marks)
    Types and its operation (8marks)

14. Explain the operation of Schmitt trigger
    Definition (2marks)
    Diagram, working and derivation of relation required (6marks)
15. Explain the process of Square wave, triangular wave and pulse generation.
    Square wave generation- write about Astable Multivibrator (6marks)
    Triangular wave generation- write about integrator circuit (6marks)‘
    Pulse generation - -write about circuit (6marks)‘
16. What is a regulator? Explain its types.
    Definition (2marks)
    Diagram, working and derivation of relation required (2marks)
    Types and its operation (4marks)
18. Explain about SMPS
    Diagram
    Explanation
19. Explain about rectifiers.
    Half wave rectifier and analysis
    Full wave rectifiers and analysis.
20 Explain bistable Multivibrator and its types?
    General form of bistable Multivibrator circuit.
    - fixed Bias transistor bistable Multivibrator circuit
    - self Bias transistor biastable Multivibrator circuit
    - Applications

21, Explain about speedup capacitors or commutating capacitors
- Practical self biased bistable Multivibrator
- Explanation about the circuit

22, Explain about Monostable Multivibrator
- Explanation about the circuit diagram
- Pulse width of collector coupled Monostable Multivibrator
- Wareforms
- Applications

23, Explain about collector coupled astable Multivibrator
- Explanation about the circuit diagram
- Wareforms
- Distration & its eliminator
- Applications

24, Explain emitter coupled astable Multivibrator
- Operation and Mathematical analysis
- Practical circuit
- Advantages and disadvantages of the Multivibrator

25, Write in detail about Schmitt Trigger circuit?
- Circuit diagram
- Operation of the circuit
- Schmitt trigger wareforms.
- Hysterisis
- Applications

26, Write about UJT sawtooth generator
- Operation
- Circuit diagram